

What is claimed is:

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A flexible coupling for use in rotatable devices, the flexible coupling comprising:

5 a female member comprising an internal surface including a female thread formed thereon;

a male member comprising an external surface including a male thread formed thereon, at least a portion of the male member is disposed within the female member such that the female thread and the male thread are intermeshed but generally spaced  
10 apart from each other; and

a layer of elastically deformable material disposed in the space between the female and male threads;

wherein at least one of the female thread and the male thread is tapered in two opposing directions with respect to a coupling centerline.

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2. The flexible coupling according to claim 1, wherein the male and female threads each have a major diameter and a minor diameter, and wherein at least one of the female thread minor diameter and the male thread major diameter is tapered in two opposing directions with respect to the coupling centerline.

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3. The flexible coupling according to claim 2, wherein both the female thread minor diameter and the male thread major diameter are tapered in two opposing directions with respect to the coupling centerline.

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4. The flexible coupling according to claim 1, wherein the elastically deformable material is an elastomer.

5. The flexible coupling according to claim 1, wherein the rotatable device comprises a drill pipe section.

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6. The flexible coupling according to claim 5, wherein the flexible coupling is located inside the drill pipe section and forms at least part of an electronics suspension system.

7. The flexible coupling according to claim 5, wherein the flexible coupling is adapted for interconnecting a plurality of drill pipe sections.

8. The flexible coupling according to claim 1, wherein the intermeshed female and male threads have a first end region and an opposing second end region, and at least one of the female thread and the male thread is double-tapered, comprising:

a first taper extending from a position proximate the first end region and toward the second end region, the first taper being defined by a first taper angle with respect to the coupling centerline; and

a second taper extending from a position proximate the second end region and toward the first end region, the second taper being defined by a second taper angle with respect to the coupling centerline.

9. The flexible coupling according to claim 8, wherein both the female thread and the male thread are double-tapered.

10. The flexible coupling according to claim 8, wherein the first taper and the second taper are inwardly directed with respect to the coupling centerline, from positions proximate the first and second end regions respectively.

11. The flexible coupling according to claim 8, wherein the first taper and the second taper are outwardly directed with respect to the coupling centerline, from positions proximate the first and second end regions respectively.

12. The flexible coupling according to claim 8, wherein the first and second taper angles are from about 1 degree to about 45 degrees.

13. The flexible coupling according to claim 12, wherein the first and second taper angles are from about 5 degrees to about 10 degrees.

14. The flexible coupling according to claim 8, wherein the first taper angle and the second taper angle are equally dimensioned.

15. The flexible coupling according to claim 8, wherein the male and female  
5 threads each have a major diameter and a minor diameter, and wherein at least one of the female thread minor diameter and the male thread major diameter is double-tapered.

16. The flexible coupling according to claim 15, wherein both the female thread  
10 minor diameter and the male thread major diameter are double-tapered.

17. The flexible coupling according to claim 15, wherein both the female thread major diameter and the male thread minor diameter are constant.

18. The flexible coupling according to claim 15, wherein one portion of the  
15 female thread major diameter is constant and another portion of the female thread major diameter is tapered.

19. A flexible coupling for interconnecting sections of drill pipe, the flexible  
20 coupling comprising:

a female member comprising an internal surface including a female thread formed thereon;

a male member comprising an external surface including a male thread formed thereon, at least a portion of the male member is disposed within the female member  
25 such that the female thread and the male thread are intermeshed but generally spaced apart from each other; and

a layer of elastically deformable material disposed in the space between the female and male threads;

wherein at least one of the female thread and the male thread is tapered in two  
30 opposing directions with respect to a coupling centerline.

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20. A flexible coupling for suspending a component within a drill pipe section, the flexible coupling comprising:

a female member comprising an internal surface including a female thread formed thereon;

5 a male member comprising an external surface including a male thread formed thereon, at least a portion of the male member is disposed within the female member such that the female thread and the male thread are intermeshed but generally spaced apart from each other; and

10 a layer of elastically deformable material disposed in the space between the female and male threads;

wherein at least one of the female thread and the male thread is tapered in two opposing directions with respect to a coupling centerline.

21. A flexible coupling for coupling a drill pipe section to a complementary device, the flexible coupling comprising:

15 a female member comprising an inner diameter, and opposing first and second ends;

20 a male member comprising an outer diameter, at least a portion of the male member being disposed within the female member such that there is a space between the male member outer diameter and the female member inner diameter; and

a layer of elastically deformable material disposed within at least a portion of the space;

25 wherein the male member outer diameter changes size at least twice along the portion of the male member disposed within the female member.

22. The flexible coupling according to claim 21, wherein overlapping portions of the female and male members define opposing first and second end regions, and wherein the space is a different size at locations proximal the first and second end region than at locations distal the first and second end regions.

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23. The flexible coupling according to claim 22, wherein the space is larger at locations proximal the first and second end regions than at locations distal the first and second end regions.

5 24. The flexible coupling according to claim 22, wherein the space is smaller at locations proximal the first and second end regions than at locations distal the first and second end regions.

10 25. The flexible coupling according to claim 21, wherein the male member comprises a threaded region including a male thread formed on an external surface thereof, the male thread having a major diameter and a minor diameter, and wherein the male member outer diameter is defined by the male thread major diameter.

15 26. The flexible coupling according to claim 25, wherein the male thread major diameter is double-tapered.

20 27. The flexible coupling according to claim 25, wherein the female member comprises a threaded region including a female thread formed on an internal surface thereof, the female thread having a major diameter and a minor diameter, and wherein the female member outer diameter is defined by the female thread major diameter.

28. The flexible coupling according to claim 21, wherein the complementary device is an adjacent drill pipe section.

25 29. The flexible coupling according to claim 21, wherein the complementary device is an electronic device.

30 30. A flexible coupling for use in rotatable devices including down hole drilling assemblies, the flexible coupling comprising:  
a female member comprising a closed end, an opposing open end, and an inner diameter;

a male member comprising an outer diameter, at least a portion of the male member being disposed within the female member such that there is a space between the male member outer diameter and the female member inner diameter; and

5 a layer of elastically deformable material disposed within at least a portion of the space;

wherein the space at a position proximate the open end is greater than the space at a position proximate the closed end.

31. The flexible coupling according to claim 30, wherein the female member  
10 comprises a female thread formed on an inner surface thereof and the male member comprises a male thread formed on an external surface thereof, and wherein the female thread and the male thread are tapered in opposing directions.

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